**Objectives**

Upon completion of this activity, you will be able to:

* Describe how energy drives movement and change in the hydrosphere and atmosphere. You should also be able to predict circulation in the atmosphere and hydrosphere may change due to global warming.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.

3. Matter moves and changes to return a system to **equilibrium.**

1. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.
2. When molecules move faster, the **density** of most substances decreases. Water is an anomaly because liquid water is more dense than ice.
3. **Buoyancy** causes materials to rise or fall due to the relative density of materials.

**PART 1: Background Notes**

Describe below how temperature affects the density of air and water and how salinity affects the density of water:

**Part 2: Group Work – Thermohaline Circulation**

Complete Table A as we did in class. Fill in the causal principles that are associated with each feature of the atmosphere. Use the causal principles listed at the beginning of this activity.

|  |  |
| --- | --- |
| **Table A. Causal Principles and the Atmosphere** | |
| **Atmosphere** | **Principle** |
| Hot and cold regions |  |
| Heat from the ground |  |
| Hot and cold air |  |
| Hadley cells |  |

Complete Table B like we did during the class example. *One of the features in Table B does not correspond to a principle that causes thermohaline circulation*. Write ***no principle*** in that box in the table.

|  |  |
| --- | --- |
| **Table B. Causal Principles and the Oceans** | |
| **Oceans** | **Principle** |
| Hot and cold regions |  |
| Heat from the ocean surface |  |
| Hot and cold water |  |
| Cold saltier water in polar regions |  |

In Table C, fill in the corresponding features for the ocean that matches with the atmosphere. *There can be more than one possible match or no match at all.* Fill in everything you can and the corresponding principles.

|  |  |  |
| --- | --- | --- |
| **Table C. Comparing Atmosphere and Ocean Circulation** | | |
| **Atmosphere** | **Ocean** | **Principle** |
| Hot and cold regions |  |  |
| Heat from the ground |  |  |
| Hot and cold air |  |  |
| Hadley Cell |  |  |

In Table D, fill in the differences between atmosphere and ocean circulation.

|  |  |  |
| --- | --- | --- |
| **Table D. Differences Between Atmosphere and Ocean Circulation** | | |
| **Difference** | **Atmosphere** | **Oceans** |
| Features related to density |  |  |
| Primary source of energy for movement |  |  |

**Part 3: Homework**

If you complete the group work, you may work on the homework **on your own.** This means your answers should be generally unique from other students’ answers. **Submit your homework using ANGEL**.

**True or False**:

1. The ocean circulation transfers heat to the polar regions.

*TRUE FALSE (circle one)*

Explain the reasoning for this answer:

2. During ocean circulation, warm water rises in the equatorial regions.

*TRUE FALSE (circle one)*

Explain the reasoning for this answer:

**Short Answer**

3. What factors can cause the circulation of air and/or water?

4. How might global warming impact the circulation of fluids? (There are multiple correct answers for this question.)